BREEDING PIERCE'S DISEASE RESISTANT WINEGRAPES

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ABSTRACT
The use of marker-assisted selection (MAS) using DNA markers tightly linked with the Pierce's disease (PD) resistance gene, *PdR1* (see our companion report), and the acceleration of the seed-to-seed breeding cycle to two years have allowed very rapid progress towards the creation of PD resistant winegrapes. Seedlings from the 2009 and 2010 crosses were screened for PD resistance with MAS and only those seedlings with the markers were planted in the field. The goals of the 2010 crosses were to: 1) expand the 97% *Vitis vinifera* seedling populations with PD resistance using *PdR1* from F8909-08 (a *V. rupestris* x *V. arizonica / candicans* b43-17 hybrid); 2) create 94% *vinifera* populations with *PdR1* from b43-17 to avoid possible disruption of resistance from *V. rupestris*; 3) enlarge the 75% *vinifera* populations with PD resistance from *V. arizonica / girdiana* b42-26 to create an alternative source of PD resistance and one controlled by multiple genes; and 4) to expand the mapping population based on b42-26 to enable identification of useful markers to expedite selection of resistant progeny based on this resistance. Numerous greenhouse-based PD resistance screens were performed on breeding lines, mapping populations and new PD resistant rootstocks. Selections with *PdR1* at the 87% and 75% *vinifera* level at our Beringer, Napa County trial were inoculated and a trial with the 94% *vinifera* level was expanded. An additional field plot with 87% and 94% *vinifera* selections was planted in Healdsburg and 87% vinifera selections were sent to Alabama and Texas for evaluation. Finally, small-scale wine lots were made from five 94% *vinifera* and four 87% *vinifera PdR1* selections. The fruit and juice were evaluated of many other promising progeny at the 94% *vinifera PdR1* level.

LAYPERSON SUMMARY
Rapid progress breeding Pierce's disease (PD) resistant winegrapes continues to be made by combining the use of marker-assisted selection (MAS) for the single dominant gene *PdR1*, and aggressive vine training to produce clusters in a seedling's second season, allowing us to rapidly generate the next generation crosses of PD resistant populations. We created the first populations of 97% *vinifera* seedlings last year and many more were created in 2010. We hope to release PD resistant cultivars from the 97% *vinifera* populations. The first seedlings of the 97% *vinifera* generation will fruit in 2011. We made wines from the 94% *vinifera* selections last year and again this fall. Last year's evaluations found the 94% *vinifera* wines to be much improved over the previous 87% *vinifera* generation; color and aroma flaws associated with American species were absent in the 94% *vinifera* wines. These selections are based on *PdR1* resistance from *V. arizonica / candicans* b43-17. We are expanding populations from other resistance sources that contain multiple genes for PD resistance. It is much slower to breed with these resistance sources and fewer resistant progeny are produced from the crosses, but they provide a very valuable alternative resistance source that we can incorporate with *PdR1* to broaden PD resistance and potentially make it more durable. We expanded our Napa Valley test site with more 94% *vinifera* selections in anticipation of evaluating wines made from there. We also planted 87% and 94% *vinifera* selections at a severe PD hot spot in Healdsburg and sent 87% *vinifera* selections to Alabama and Texas for evaluation under severe PD pressure.

INTRODUCTION
The Walker lab is uniquely poised to undertake this important breeding effort, having developed rapid screening techniques for *Xylella fastidiosa* (*Xf)* resistance (Buzkan et al. 2003, Buzkan et al. 2005, Krivanek et al. 2005a 2005b, Krivanek and Walker 2005), and having unique and highly resistant *V. rupestris* x *V. arizonica* selections, as well as an extensive collection of southeastern grape hybrids, to allow the introduction of extremely high levels of *Xf* resistance into commercial grapes. We have made wine from vines that are 94% *V. vinifera*, and possess resistance from the b43-17 *V. arizonica* / *candicans* resistance source. There are two sources of *PdR1*, 8909-08 and 8909-17 – sibling progeny of b43-17. These selections have been introgressed into a wide range of winegrape backgrounds over multiple generations, and resistance from southeastern United States (SEUS) species is being advanced in other lines. However, the resistance in these later lines is complex and markers have not yet been developed to expedite breeding.

OBJECTIVES
1. Breed Pierce's disease (PD) resistant winegrapes through backcross techniques using high quality *V. vinifera* winegrape cultivars and *Xf* resistant selections and sources characterized from our previous efforts.
2. Continue the characterization of *Xf* resistance and winegrape quality traits (color, tannin, ripening dates, flavor, productivity, etc) in novel germplasm sources, in our breeding populations, and in our genetic mapping populations.

RESULTS AND DISCUSSION

Objective 1 – The breeding cycle for the development of PD resistant grapes has been reduced to two years (seed-to-seed) using MAS with the b43-17 resistance sources and their progeny. In order to take full advantage of *PdR1* we have focused our breeding efforts on backcrossing through multiple generations as quickly as possible to achieve a high percentage of *V. vinifera* parentage in hybrids containing resistance from *PdR1*. This is only possible with MAS and aggressive training practices in the vineyard to force seedlings to bloom in their second year. We produced 97% *V. vinifera* progeny last year, which were established in the vineyard this spring, and have added additional populations this year. Progeny from the 97% *V. vinifera* populations will begin fruiting in 2011. We will select individuals from these populations for wine evaluation and field-testing.

Table 1 presents the crosses made in 2010. The goals of the 2010 crosses were to: 1) Use the *PdR1* allele from F8909-08 to advance *vinifera* winegrape populations to the 97% *vinifera* (modified backcross 4 (BC)) level. These populations will be evaluated for winegrape quality and potential, and individuals will be moved to field testing followed by selection and testing for cultivar release. Seedlings from these populations will be germinated in late fall and planted in the Field in spring 2011 with the first fruit production in 2012. 2) Create populations at the 94% *vinifera* level (BC3) using resistance from *V. arizonica/candicans* b43-17. b43-17 is the source of *PdR1* and using it in crosses avoids possible confounding effects from *V. rupestris*, which was crossed with b43-17 to produce the F8909-08 and F8909-17 PD resistance selections. *Vitis rupestris* may interfere with *PdR1* expression and it is the likely source of diglucoside anthocyanins (blue purple wine color) that we detect in early generations of the backcrossing program. 3) Expand and develop BC1 populations with *V. vinifera* winegrapes using resistance from *V. arizonica/girdiana* b42-26. b42-26 has strong resistance to PD but has a complex resistance controlled by multiple genes. These crosses create 75% *vinifera* populations with an alternative PD resistance source and one controlled by multiple genes. The multigenic nature may provide a more durable resistance, but progress in selecting and backcrossing will be much slower than with *PdR1*. 4) Finally we made crosses to expand a mapping population to study the genetics of PD resistance from b42-26 and determine whether DNA makers linked to this resistance source can be found and used. We have commenced mapping in the 05347 population and this next generation (07344A) will help confirm the location and usefulness of the multiple markers we are discovering.

During this period, eight groups of plants were tested in the greenhouse for *Xf* resistance (**Table 2**). Table 2 presents the inoculation date and the "take-down" date when ELISA samples are gathered. Group A was a retest of the 94% *vinifera PdR1* parents used in the 2009 crosses. They were tested three times to ensure they had the highest resistance and to follow the extent that level of resistance (based on the level of *Xf* in a ml of macerated stem tissue) is passed through to the next generation. We run a series of bio-controls with these tests that consist of *PdR1* containing selections with consistently relatively high, medium and low levels of *Xf* in stem tissue. This process also helps judge the severity of each greenhouse screen, the results of which vary based on how well the greenhouse temperatures are regulated and the temperature's interaction with irrigation needs. Group B and D tests also focused on further assessing 94% *vinifera PdR1* selections some of which we have made wines from. Selections from these populations were also made to evaluate the impact of different *vinifera* winegrapes on the level of PD resistance. The results found that although there are cultivar differences in the levels of *Xf* in stem tissue after inoculation, the impact on resistance breeding is small if detectable (see below).

Group C was an examination of the impact of *Xf* strain selection on the severity of the greenhouse testing system. These tests were initiated after the severity of the greenhouse testing results, both in terms of plant symptoms and ELISA values, was declining when the Stag's Leap *Xf* strain was used. This strain still grew well in culture but was not being passaged back to susceptible *vinifera* hosts as often as in the past. We compared new isolates from Yountville (Beringer) and Dry Creek (Mounts) with lab cultures of Temecula and Stag's Leap strains, and Stag's Leap that was inoculated and re-extracted from Chardonnay in the greenhouse. The Beringer strain was the most aggressive while Mounts and Temecula were intermediate. Both Stag's Leap strains were less aggressive and lab cultured Stag's Leap strain was the least aggressive.

Groups E and F are the continued testing on *PdR1* containing rootstock crosses we have made. These rootstocks are being created to prevent vine death if PD resistant scions are grafted onto standard rootstocks, the majority of which are susceptible to PD. The *PdR1* winegrape selections greatly suppress *Xf* populations, but to avoid having low levels of *Xf* work their way down to the rootstock and killing it, resistant rootstocks are needed. We have done some nematode testing of these rootstocks as well. This year's tests were done to fine-tune the selection of those with the highest level of resistance.

The Group G tests are the first series of greenhouse screens for the 97% *vinifera PdR1* containing winegrapes that were planted in the spring of 2010. We planted the strongest of this group on our Y-trellis in anticipation of some fruit next year and adequate amounts for micro-scale wine making in 2011. Micro-scale winemaking will be much more possible now that the new Department winery is competed with its adjustable volume mini-fermenters with computer controlled temperatures and automated pump-overs. The final group, H, consists of 122 members of a mapping population created and tested to position the resistance genes from b42-26. We hope to link simple sequence repeat (SSR) markers to the genes controlling this resistance. These markers will be very important in efforts to combine this resistance with *PdR1* selections to broaden their PD resistance.

Objective 2 - Although resistance from other backgrounds is complex and quantitative, which results in few resistant progeny from crosses to *vinifera* cultivars, we continue to advance a number of lines. In order to better understand the limits of other PD resistance sources the following resistance sources are being studied:

V. arizonica/girdiana b42-26 – **We** have two mapping populations to explore *Xf* resistance from b42-26. A framework map of the first population, 0023, has been developed and found that resistance is controlled by multiple genes. The 0023 is a cross of (D8909-15 (*V. rupestris* x b42-26) x *V. vinifera* B90-116). Please see past reports for more information on results with the 0023 population. Because this resistance source is multigenic we need far more individuals to detect useful markers to resistance genes and to help determine which of these markers are linked to the genes responsible for the greatest extent of the resistance. We also wanted a population without *V. rupestris*, and so created the 05347 (*vinifera* F2-35 x b42-26) population. We have several hundred 05347 progeny and made crosses this year (760 seed expected) to further expand the population to allow better mapping.

We are also incorporating resistance from *V. shuttleworthii* Haines City and *V. arizonica* b40-14. Preliminary results found that b40-14 has a different form of *PdR1*. We are backcrossing to *V. vinifera* winegrapes with these resistance sources and working towards developing markers in our companion project, "Map-based identification and positional cloning of *Xf* resistance genes from different known sources of PD resistance in grapes".

Evaluating V. vinifera *cultivars and parental selections* – A previous study by Raju and Goheen (1981 Am. J. Vitic. Enol. 32:155-158) ranked 25 *V. vinifera* cultivars as sensitive to tolerant to PD based on ELISA readings from greenhouse screened plants. We wanted to retest many of our parents to determine if there was any possible contribution of varying levels of susceptibility or tolerance in our parents to the progeny. If this effect exists it does not seem to be consistent in our populations. This screening also gave us the opportunity to compare our greenhouse results with those of Raju and Goheen. **Table 3** presents these data on 34 winegrapes and bio-control standards. Our bio-control standards were included in this test and behaved as expected with *V. arizonica/candicans* b43-17 having very low values (equivalent to un-inoculated Chardonnay). The values for U0505-01 were also typically low as was Roucaneuf, a French hybrid (SV 12.309). We also use U0505-35 and -22 as bio-controls because although they contain *PdR1* they typically have moderate levels of *Xf*. Genotypes with *PdR1* generally have mean values of *Xf* (cfu/ml) lower than 500,000. We try to select parents with values below 100,000. Chenin blanc and Sylvaner were the least susceptible in the Raju and Goheen study and Sylvaner had the lowest values in our test. Its values were equivalent to Blanc du Bois, which hosts relatively high levels of *Xf* but suppresses symptom expression and survives in the southern US. Chenin blanc was intermediate in our test. Other contradictory results were Cabernet Sauvignon, which was highly susceptible in Raju and Goheen's test but moderately intermediate in our test. However, overall the groupings were similar. Although both tests were performed in the greenhouse, the inoculation techniques were different (needle inoculation vs vacuum infusion) and the greenhouse conditions, including irrigation and temperature control, which have a large influence on symptom expression and *Xf* build up but were hard to compare

Field Testing – Testing of advanced selections continues at the Beringer vineyard in Yountville, CA. In addition to natural PD pressure in this Napa Valley hot spot, we needle inoculate each spring. Eleven selections from the BC3, 94% *vinifera* crosses, grafted on our PD resistant rootstock selections, were planted at Beringer in July 2010. They are listed next followed with their last *V. vinifera* parent: 07329-01, 07329-037 (Chardonnay), 07355-042, 07355-048, 07355-057, 07355-075 (Petite Sirah), 07370-128, 07371-025, 07371-027 and 07713-051 (Carignane x Cabernet Sauvignon). We also planted a field trial at the Mounts Vineyard in Healdsburg in June 2010 with 07329-37, 07355-75 and 07713-51 (all three 94% *vinifera* with *PdR1*), and U0502-20 (87% *vinifera* with *PdR1*). These vines were planted with varying numbers of five vine replicates. The site is surrounded by PD habitat on two sides and is chronically and severely infected, they will also be needle inoculated. We sent 87% *vinifera PdR1* to Dr. Elina Coneva at Auburn University in Alabama 501-12 (50% Syrah) 30 plants, 502-01 (50% Chardonnay) 32 plants and 502-10 (50% Chardonnay) 34 plants. They were repotted there and will be planted out in spring 2011. We also sent cuttings of five 87% *vinifera PdR1* selections to Jim Kamas in Fredericksburg, TX for a trial there (U0502-10, U0502-20, U0502-26, U0502-38 and U0505-35). A trial with most of these is underway in Galveston, TX in collaboration with Lisa Morano.

Wine Making – Wines were made this fall from four 88% and five 94% *vinifera PdR1* selections growing in the evaluation block at UCD. A full description of the fruit and juice is in **Table 4**. ETS Laboratories (www.etslabs.com) of St. Helena kindly donated their fruit analysis and phenolics panel, which uses a wine-like extraction to model a larger fermentation. Wine evaluations will occur later this winter.

CONCLUSIONS

This project continues to breed PD resistant winegrapes with the primary focus on the *PdR1* resistance source so that progress can be expedited with MAS. Populations with *Xf* resistance from other sources are being maintained and expanded, but progress is slower with these sources. We continue to supply plant material, conduct greenhouse screens and develop new mapping populations for our companion project on fine-scale mapping of PD resistance to allow the characterization of the *PdR1* resistance locus. Small-scale wine making continues with advanced 94% *vinifera* selections and these selections scored very well last year. In 2011, we should make the first small wines from Napa trials with the 94% *vinifera* selections.

We plan to release PD resistant cultivars from the 97% *vinifera* populations we planted this year – they will begin fruiting in summer 2011, and continue to produce additional 97% vinifera populations with different last generation winegrape parents.

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Table 1. 2010 crosses to produce winegrapes and mapping populations with the estimated number of seeds produced.

Resistant Type	*Vinifera* Parent\grandparent of Resistant Type	*Vinifera* Types used in 2010 crosses	Estimated # of Seed
1a. Monterrey *V. arizonica/candicans* resistance source (F8909-08 = *V rupestris* x *V. arizonica/candicans* b43-17) to produce progeny with 96.875% *V. vinifera* parentage. F2-35 is 100% vinifera cross of Cabernet Sauvignon x Carignane.			
07355-020	Petite Sirah\Cabernet Sauvignon	Barbera	85
07370-028	F2-35\Chardonnay	Chardonnay, Riesling	750
07371-20	F2-35\Chardonnay	Barbera	350
1b. Monterrey *V. arizonica/candicans* (b43-17) *PdR1a* resistance source to produce progeny with 93.75% *V. vinifera* parentage, without the possible confounding effect of *V. rupestris*, which is in 8909-08 or 8909-17.			
08329-035	Tannat\Chenin blanc	Cabernet Sauvignon	85
08329-074	Tannat\Chenin blanc	Cabernet Sauvignon, Carignane	900
08329-095	Tannat\Chenin blanc	Cabernet Sauvignon	240
1c. Crosses to the b42-26 *V. arizonica/girdiana* resistance source to produce progeny that are 75% vinifera and 25% the resistance source.			
07344A-09	Grenache	Carignane	225
07344A-11	Grenache	Carignane, Cabernet Sauvignon, Chardonnay	315
07344A-12	Grenache	Carignane	180
07344A-15	Grenache	Carignane	360
07344A-25	Grenache	Carignane	360
07344A-32	Grenache	Carignane	180
07344A-33	Grenache	Carignane, Cabernet Sauvignon	180
07344A-51	Grenache	Carignane	225
07344A-54	Grenache	Carignane, Cabernet Sauvignon	270
07344A-56	Grenache	Carignane, Cabernet Sauvignon	270
07344A-61	Grenache	Carignane, Cabernet Sauvignon	360
1d. Cross to increase the 07344A *V. arizonica/girdiana* b42-26, 75% *vinifera* possible mapping population.			
05347-02	F2-35	Grenache	760

Table 2. PD resistant winegrape progeny completed or currently in greenhouse screening for PD resistance.

Group	Genotypes	# Genotypes	Inoculation Date	ELISA Date	Resistance Source(s)
A	2009 *PdR1* parents	50	11/24/09	2/25/10	F8909-08
B	94% *vinifera* parents and selections	68	12/8/09	3/9/10	F8909-08
C	*Xf* strain trial	6	3/30/10	7/6/10	F8909-08
D	94% *vinifera* parents and selections -2	145	4/13/10	7/22/10	F8909-08
E	PD rootstock test	35	6/8/10	9/30/10	F8909-08
F	08 PD stocks & recombinants	22	7/15/10	10/14/10	F8909-08
G	97% *vinifera* tests	23	7/26/10	11/22/10	F8909-08
H	05347 b42-26 mapping	122	9/23/10	12/19/10	b42-26

Table 3. Greenhouse screen results for *V. vinifera* cultivars used in our crosses and a broad range selected from a previous screen by Raju and Goheen (Amer. J. Vitic. Enol. (1981) 32:155-158)

Genotype	t-test	GH Screen Result (ref U0505-01)	Geometric mean (cfu/ml)	Mean (ln cfu/ml)	Std Error (ln cfu/ml)	Reps
Chard un-inoculated	A	R	11,959	9.4	0.1	5
b43-17	A	R	14,830	9.6	0.4	5
U0505-01	B	R	36,268	10.5	0.5	5
Roucaneuf	C	R	90,174	11.4	0.8	5
U0505-35	D	S	403,729	12.9	0.9	5
U0505-22	DE	S	695,510	13.5	0.8	4
Sylvaner	EF	S	1,099,207	13.9	0.8	4
Blanc du bois	EFG	S	1,290,448	14.1	0.4	4
Exotic	FGH	S	1,985,339	14.5	0.3	5
Zinfandel	FGHI	S	2,408,705	14.7	0.3	5
Grenache	FGHI	S	2,519,321	14.7	0.3	5
Napa Gamay	GHIJ	S	2,985,566	14.9	0.1	4
Chenin blanc	GHIJ	S	3,089,439	14.9	0.3	5
Gewurztraminer	GHIJ	S	3,104,925	14.9	0.3	5
Carnelian	GHIJ	S	3,552,279	15.1	0.2	3
Carignane	HIJ	S	3,612,462	15.1	0.2	5
Helena	HIJ	S	3,794,260	15.1	0.2	4
Green Hungarian	HIJ	S	4,171,557	15.2	0.2	5
Cabernet Franc	HIJ	S	4,654,290	15.4	0.1	5
Alicante Bouschet	HIJ	S	4,654,756	15.4	0.2	4
Mataro	IJ	S	4,753,539	15.4	0.1	5
Merlot	IJ	S	4,800,353	15.4	0.1	5
White Riesling	IJ	S	5,103,310	15.4	0.1	5
Sauvignon blanc	IJ	S	5,113,016	15.4	0.1	5
Colombard	IJ	S	5,147,903	15.5	0.1	5
F2-35	IJ	S	5,192,366	15.5	0.2	5
Chardonnay	IJ	S	5,480,462	15.5	0.2	3
Melon	IJ	S	5,554,950	15.5	0.1	5
Early Burgundy	IJ	S	5,623,698	15.5	0.1	4
Mission	IJ	S	5,991,785	15.6	0.1	4
F2-7	IJ	S	6,009,788	15.6	0.1	4
Palomino	J	S	6,036,289	15.6	0.0	5
Malbec	IJ	S	6,194,052	15.6	0.0	3
Petite Sirah	J	S	6,337,532	15.7	0.0	5
Rosa Minna	J	S	6,366,115	15.7	0.0	4
Ugni blanc	J	S	6,394,188	15.7	0.0	5
Monukka	J	S	6,496,018	15.7	0.0	5
Barbera	J	S	6,499,917	15.7	0.0	4
Cabernet Sauvignon	J	S	6,499,917	15.7	0.0	5
Flora	IJ	S	6,499,917	15.7	0.0	3
Pinot noir	J	S	6,499,917	15.7	0.0	5

Table 4a. Phenotypic observations of reference varieties and select progeny with the *PdR1* resistance source used for small lot winemaking in 2010.

Genotype	Parentage	Percent *vinifera*	2009 Bloom Date	Berry Color	Berry Size (g)	Ave Cluster Wt. (g)	Ripening Season	Prod 1=v low, 9=v high
Chardonnay	Gouais blanc x Pinot noir	100	5/22/10	W	1.0	190	early	5
07355-12	U0505-01 x Petite Sirah	94	5/25/10	B	1.2	246	early-mid	6
07355-42	U0505-01 x Petite Sirah	94	5/27/10	B	1.4	169	late	6
07355-75	U0505-01 x Petite Sirah	94	5/20/10	B	1.4	265	early	8
07713-51	F2-35 x U0502-48	94	5/19/10	W	1.4	310	early	8
07713-55	F2-35 x U0502-48	94	5/21/10	W	1.2	270	early-mid	5
U0502-10	A81-138 x Chardonnay	87	5/21/10	B	1.3	320	early	7
U0502-20	A81-138 x Chardonnay	87	5/28/10	W	1.3	150	late	8
U0502-26	A81-138 x Chardonnay	87	5/24/10	B	2.0	480	mid	7
U0505-35	A81-138 x Cab. Sauvignon	87	5/25/10	B	1.3	158	early	6
Blanc du Bois	Fla D6-148 x Cardinal	~66	5/26/10	W	2.8	175	mid-late	7
Lenoir	*V. aestivalis* hybrid	<50	6/2/10	B	1.3	157	late	6

Table 4b. Analytical evaluation of advanced selections with the *PdR1* resistance source used for small lot winemaking in 2010. Analysis courtesy of ETS Laboratories, St. Helena, CA.

Genotype	L-malic acid (g/L)	°Brix	potassium (mg/L)	pH	TA (g/100mL)	YAN (mg/L, as N)	catechin (mg/L)	tannin (mg/L)	Total antho-cyanins (mg/L)
07355-12	1.38	27.7	1990	3.25	0.90	326	82	512	2369
07355-42	1.69	26.4	1820	3.53	0.59	356	148	642	1787
07355-75	2.93	28.3	2230	3.43	0.80	275	14	555	1680
07713-51	2.59	22.6	1400	3.48	0.59	194	-	-	-
07713-55	5.87	24.3	1230	3.25	0.98	293	-	-	-
U0502-10	3.65	25.5	1850	3.40	0.80	340	78	640	1193
U0502-20	2.33	23.5	1640	3.37	0.75	357	-	-	-
U0502-26	2.71	24.6	2000	3.40	0.79	340	85	272	741
U0505-35	5.44	27.9	2010	3.41	9.60	397	118	820	1609
Lenoir	7.03	24.8	2240	3.22	1.21	183	186	268	2486

Table 4c. Sensory evaluation of reference varieties and advanced selections with the *PdR1* resistance source used for small-scale winemaking in 2010.

Genotype	Juice Hue	Juice Intensity	Juice Flavor	Skin Flavor	Skin Tannin (1=low, 4= high)	Seed Color (1=gr, 4= br)	Seed Flavor	Seed Tannin (1=high, 4= low)
Chardonnay	gold-brown	medium	apple, pear	sl fruity	1	3.5	nutty	4
07355-12	red	med-dark	red fruit	berry, fruity	2	3	spicy, hot	3
07355-42	pink-red	lt-med	fruity, honey	CS-veg	2	3	spicy	1
07355-75	pink-red	medium	plum, fruity	ripe red fruit	1	3	spicy	1
07713-51	gold-brown	medium	floral	neutral	2	4	mild spice	4
07371-55	green	pale	neutral, tart	neutral	1	4	woody	4
U0502-10	pink	light	red fruit	sl fruity, hay	2	4	nutty, spicy	2
U0502-20	pink-brown	lt-med	fruity-spicy	neutral, hay	1	3	spicy, bitter	1
U0502-26	green-brown	medium	honey, spicy	neutral	1	4	clove, spice	3
U0505-35	red-sl brown	medium	CS-veg, berry	sl vegetal	1	3	nutty	3
Blanc du Bois	brown-green	medium	floral, apple	sl vegetal	1	4	woody, bitter	3
Lenoir	red	med-dark	mildly fruity	fruity	1	4	hot	4